1. What are the *possible Rational* roots of the polynomial below?

$$f(x) = 6x^4 + 2x^3 + 4x^2 + 5x + 4$$

A. $\pm 1, \pm 2, \pm 4$

B. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 2, \pm 3, \pm 6}$

C. $\pm 1, \pm 2, \pm 3, \pm 6$

D. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 3, \pm 6}{\pm 1, \pm 2, \pm 4}$

E. There is no formula or theorem that tells us all possible Rational roots.

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2. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{12x^3 - 36x - 28}{x - 2}$$

A. $a \in [11, 16], b \in [10, 17], c \in [-27, -21]$, and $r \in [-55, -47]$.

B. $a \in [24, 25], b \in [-49, -46], c \in [60, 64]$, and $r \in [-150, -142]$.

C. $a \in [11, 16], b \in [-26, -23], c \in [11, 17]$, and $r \in [-55, -47]$.

D. $a \in [24, 25], b \in [47, 50], c \in [60, 64]$, and $r \in [91, 96]$.

E. $a \in [11, 16], b \in [24, 26], c \in [11, 17]$, and $r \in [-5, -1]$.

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3. Factor the polynomial below completely, knowing that $x - 4$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^4 - 61x^3 + 15x^2 + 178x - 120$$

A. $z_1 \in [-0.96, -0.32]$, $z_2 \in [1.3, 2.27], z_3 \in [1.63, 2.06]$, and $z_4 \in [3.61, 4.69]$

B. $z_1 \in [-5.22, -3.24]$, $z_2 \in [-2.02, -0.96], z_3 \in [-0.28, -0.21]$, and $z_4 \in [4.73, 5.53]$

C. $z_1 \in [-2.16, -1.43]$, $z_2 \in [0.41, 0.76]$, $z_3 \in [1.63, 2.06]$, and $z_4 \in [3.61, 4.69]$

D. $z_1 \in [-5.22, -3.24]$, $z_2 \in [-2.02, -0.96]$, $z_3 \in [-0.87, -0.32]$, and $z_4 \in [1.55, 1.79]$

E. $z_1 \in [-5.22, -3.24]$, $z_2 \in [-2.02, -0.96]$, $z_3 \in [-1.42, -1.27]$, and $z_4 \in [-0.02, 0.92]$

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4. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 10x^3 - 49x^2 + 42x + 45$$

A. $z_1 \in [-1.8, -1.5]$, $z_2 \in [0.33, 0.84]$, and $z_3 \in [2.97, 3.01]$

B. $z_1 \in [-5.1, -4.2]$, $z_2 \in [-3.32, -2.82]$, and $z_3 \in [0.28, 0.38]$

C. $z_1 \in [-3.1, -2.9]$, $z_2 \in [-1.21, -0.2]$, and $z_3 \in [1.64, 1.76]$

D. $z_1 \in [-0.7, 0.4]$, $z_2 \in [2.4, 2.99]$, and $z_3 \in [2.97, 3.01]$

E. $z_1 \in [-3.1, -2.9]$, $z_2 \in [-2.57, -2.28]$, and $z_3 \in [0.47, 0.78]$

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5. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 15x^3 + 94x^2 + 101x + 30$$

A. $z_1 \in [-5.29, -4.77]$, $z_2 \in [-2, -1.62]$, and $z_3 \in [-1.7, -1.3]$

B. $z_1 \in [-0.77, 0.55]$, $z_2 \in [1.75, 2.15]$, and $z_3 \in [4.3, 5.2]$

C. $z_1 \in [0.52, 0.97]$, $z_2 \in [0.63, 0.76]$, and $z_3 \in [4.3, 5.2]$

D. $z_1 \in [1.45, 1.92]$, $z_2 \in [1.29, 1.9]$, and $z_3 \in [4.3, 5.2]$

E. $z_1 \in [-5.29, -4.77]$, $z_2 \in [-0.83, -0.09]$, and $z_3 \in [-1.1, 1.1]$

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6. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 - 18x^2 - 36x + 43}{x - 4}$$

A. $a \in [5, 7]$, $b \in [5, 11]$, $c \in [-12, -10]$, and $r \in [-10, -3]$.

B. $a \in [24, 28]$, $b \in [-117, -109]$, $c \in [414, 423]$, and $r \in [-1638, -1632]$.

C. $a \in [24, 28]$, $b \in [73, 79]$, $c \in [272, 279]$, and $r \in [1145, 1153]$.

D. $a \in [5, 7]$, $b \in [-45, -36]$, $c \in [132, 137]$, and $r \in [-490, -482]$.

E. $a \in [5, 7]$, $b \in [-4, 4]$, $c \in [-38, -31]$, and $r \in [-68, -63]$.

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7. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{20x^3 - 65x^2 - 160x - 72}{x - 5}$$

A. $a \in [15, 23]$, $b \in [32, 39]$, $c \in [13, 23]$, and $r \in [2, 4]$.

B. $a \in [96, 103]$, $b \in [427, 441]$, $c \in [2012, 2022]$, and $r \in [9997, 10006]$.

C. $a \in [15, 23]$, $b \in [14, 17]$, $c \in [-104, -98]$, and $r \in [-479, -467]$.

D. $a \in [15, 23]$, $b \in [-172, -161]$, $c \in [663, 670]$, and $r \in [-3400, -3394]$.

E. $a \in [96, 103]$, $b \in [-565, -560]$, $c \in [2665, 2671]$, and $r \in [-13401, -13395]$.

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8. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{12x^3 + 52x^2 - 62}{x + 4}$$

A. $a \in [10, 14], b \in [3, 9], c \in [-21, -13]$, and $r \in [1, 8]$.

B. $a \in [-55, -46], b \in [-141, -136], c \in [-569, -557]$, and $r \in [-2302, -2299]$.

C. $a \in [-55, -46], b \in [244, 248], c \in [-976, -972]$, and $r \in [3838, 3846]$.

D. $a \in [10, 14], b \in [94, 102], c \in [394, 403],$ and $r \in [1537, 1539]$.

E. $a \in [10, 14], b \in [-13, -5], c \in [36, 41],$ and $r \in [-267, -260]$.

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9. Factor the polynomial below completely, knowing that $x+4$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^4 - 23x^3 - 244x^2 + 235x + 300$$

A. $z_1 \in [-4.25, -3.89],\ z_2 \in [-0.85, -0.62], z_3 \in [1.41, 1.73],$ and $z_4 \in [4.1, 5.5]$

B. $z_1 \in [-6.08, -4.94],\ z_2 \in [-0.65, -0.56], z_3 \in [1.32, 1.36],$ and $z_4 \in [3.9, 4.7]$

C. $z_1 \in [-6.08, -4.94],\ z_2 \in [-0.49, -0.34], z_3 \in [2.96, 3.22],$ and $z_4 \in [3.9, 4.7]$

D. $z_1 \in [-4.25, -3.89],\ z_2 \in [-1.37, -1.11], z_3 \in [0.45, 0.66],$ and $z_4 \in [4.1, 5.5]$

E. $z_1 \in [-6.08, -4.94],\ z_2 \in [-1.84, -1.45], z_3 \in [0.7, 0.83],$ and $z_4 \in [3.9, 4.7]$

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10. What are the *possible Integer* roots of the polynomial below?

$$f(x) = 4x^4 + 2x^3 + 4x^2 + 6x + 6$$

A. $\pm 1, \pm 2, \pm 3, \pm 6$

B. $\pm 1, \pm 2, \pm 4$

C. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 3, \pm 6}{\pm 1, \pm 2, \pm 4}$

D. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 2, \pm 3, \pm 6}$

E. There is no formula or theorem that tells us all possible Integer roots.
